CLAIMS

The present invention is applicable to systems to process Loadflow computation by means of modified real and reactive power residues, and gain matrices derived from the Jacobian matrix. The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A method of controlling security (over load, under/over voltage) in a power system, comprising the steps of:

obtaining on-line data of nodal injections, voltages and phases at main nodes, and open/close status of circuit breakers in the power system,

establishing initial specifications of controlled parameters (real and reactive power at PQ-nodes, real power and voltage magnitude at PV-nodes, and transformer turns ratios etc.),

performing Loadflow computation at said nodes of the power system by a Super Super Decoupled computation in any of the Super Super Decoupled Loadflow methods or any of their hybrid combination or simple variants employing corresponding gain matrices derived from a super decoupled Jacobian matrix for real power with respect to angle and a super decoupled Jacobian matrix for reactive power with respect to voltage, and involving triangular factorization of said gain matrices and computing of discrepancy of real power and reactive power from specified values through such nodes,

said computing including introducing variables representing quotients of the transformed discrepancies from specified values of real and reactive power flowing in through each node divided by voltage, or square of the voltage in case of transformed real power mismatches in methods employing (1θ, $1V$) iteration scheme, on each node, and using such variables to calculate values of angle and voltage for said transformed discrepancies from specified values of real and reactive power flowing in through each node, by using triangular factorization of said gain matrices for real and reactive power,

initiating said Loadflow computation with guess solution of the same voltage magnitude and angle as those of the slack (reference) node referred to as slack start,

restricting nodal transformation angle to maximum -48 degrees, applied to complex power injection in computing said transformed discrepancies from specified values of real and reactive power flowing in through each node,

evaluating the computed Loadflow for security (over load, under/over voltage),

correcting one or more controlled parameters with said correction (amount of over load and/or under/over voltage) values and repeating the computing and evaluating steps until evaluating step finds a good power system (no over load, no under/over voltage), and

effecting a change in the voltages and phases at said nodes of the power system by actually implementing the finally obtained values of controlled parameters after evaluating step finds a good power system.

2. A method as defined in claim1 wherein said Super Super Decoupled methods, employing successive (1θ, 1V) iteration scheme, of Loadflow computation are characterized in modifying the transformed real power residue at a PQ-node and real power residue at a PV-node by dividing them by squared voltage magnitude multiplied by a factor determined as a ratio of a diagonal element of susceptance matrix to a diagonal element of corresponding said gain matrix derived from transformed Jacobian matrix for real power with respect to angle.

3. A method as defined in claim1 wherein said Super Super Decoupled methods, employing simultaneous (1V, 1θ) iteration scheme, of Loadflow computation are characterized in that they involve only one time calculation of real and reactive power residues in an iteration unlike two calculations in successive (1θ, 1V) iteration scheme, and thereby achieving consequent speed-up.

4. A simple system/method of controlling generator and transformer voltages of more elaborate method of security control defined in claim 1 can be realised in a

system for controlling generator and transformer voltages in an electrical power utility containing plurality of electromechanical rotating machines, transformers and electrical loads connected in a network, each machine having a reactive power characteristic and excitation element which is controllable for adjusting the reactive power generated or absorbed by the machine, and some of the transformers having controllable taps for adjusting terminal voltage, said system comprising:

means defining any of Super Super Decoupled models of the network for providing an indication of the quantity of reactive power to be supplied by generators including at a reference node in dependence on representations of selected network electrical parameters,

machine control means connected to the said excitation element of at least one of the rotating machines for controlling the operation of the excitation element of at least one machine to produce or absorb the amount of reactive power indicated by said model means with respect to the set of representations.

5. A system as defined in claim 4 wherein the network includes a plurality of nodes each connected to at least one of: a reference generator; a rotating machine; and an electrical load, and the model has one of the 3-forms and their variants of Super Super Decoupled matrices which receives representations of selected values of the real and reactive power flow from each machine and to each load, and the model is operative for producing calculated values for the reactive power quantity to be produced or absorbed by each machine.

6. A system as defined in claim 4 wherein the utility further has at least one transformer having an adjustable transformation ratio, and said means defining a model is further operative for producing a calculated value for the transformer transformation ratio.

7. A system as defined in claim 4 wherein said machine control means are connected to said excitation element of each machine for controlling the operation of the excitation element of each machine.

8. A system as defined in claim 4 wherein said transformation ratio control means are connected to said transformer tap changing element of each transformer for controlling the operation of the transformer tap changing element of each transformer.

9. A method for controlling generator and transformer voltages in an electrical power utility containing plurality of electromechanical rotating machines, transformers and electrical loads connected in a network, each machine having a reactive power characteristic and excitation element which is controllable for adjusting the reactive power generated or absorbed by the machine, and some of the transformers having controllable taps for adjusting terminal voltage, said method comprising:

creating any of said Super Super Decoupled models of the network for providing an indication of the quantity of reactive power to be supplied by the generators in dependence on representations of selected network electrical parameters,

controlling the operation of the excitation element of at least one machine to produce or absorb the amount of reactive power indicated by any of the said Super Super decoupled models with respect to the set of specified parameters.

10. A method as defined in claim 9 wherein said step of controlling is carried out to control the excitation element of each machine.

11. A method as defined in claim 9 wherein said step of controlling is carried out to control the tap-changing element of each transformer.